EPHEMERIS OF SWIFT'S COMET.

The following is a continuation of Mr. Upton's Ephemeris, which he has corrected by observations made at Washington up to Jan. 7, 1881. Mr. Wendell, at Harvard College Observatory, obtained an observation for position on Jan. 3, and Prof. Hall is of the opinion that the comet can be followed without great difficulty, even after the present moon.

EPHEMERIS—WASHINGTON MIDNIGHT.

1881	R. A. h. m. s.	Dec. ° ′
Jan. 11	6 0 26	+26 57.4
13	6 2 52	26 23.6
15	6 5 15	25 52 2
17	6 7 34	25 22.9
19	6 9 51	24 55 6
21	6 12 7	24 30.2
23	6 14 21	24 6.5
25	6 16 35	23 44 3
27	6 18 48	23 23 5
29	6 21 2	23 4 0
31	6 23 16	+22 45.8

WASHINGTON, D. C., January 8, 1881. W. C. W.

ECLIPSE OF THE SUN.

The partial eclipse of the Sun which occurred on December 31, 1880, was observed with the spectroscope at my private observatory.

For this purpose, the instrument was so adjusted that it would present its slit radially to the limb of the Moon; and the C line was placed in the centre of the field, in order to see any solar protuberance that might be at the place of observation.

At about the time of greatest obscuration, the slit was directed on the Moon's limb outside of the Sun, at some distance from its western cusp. Although the limb of the Moon was absolutely invisible in the telescope outside of the Sun, as ascertained before, yet, the presence of the satellite was immediately made known in the spectroscope, where it gave a very distinct broad grayish band spectrum, running along the brighter spectrum of the vicinity of the Sun.

The phenomenon became more apparent the nearer the slit was moved towards the Sun, and it vanished from sight when it was at a distance estimated at 3 or 4 minutes from the solar limb.

As the eclipse drew nearer the end, the phenomenon became less and less conspicuous on the western side, and at about 9 o'clock it had almost entirely ceased.

An unsuccessful attempt was made to observe the phenomenon taking place at the point of last contact, when the Moon's limb left that of the Sun. For this purpose the slit of the instrument was placed radially to the point of emergence. But either because no phenomenon was perceptible, or perhaps rather because the slit was not exactly at the right place, nothing was seen.

If the dull spectrum obtained when the slit of the spectroscope was placed in the immediate vicinity of the Sun was due only to the solar light, which is reflected by our atmosphere, it is plain that this spectrum would have been as bright on the Moon as it was outside of it, since the terrestrial atmosphere lies as necessarily between the observer and the Moon as it does between us and the Sun, and therefore no dark band spectrum could have been seen. But as it was visible, it must be inferred that besides the spectrum given off by the solar light reflected by our atmosphere, there must have been some other light, either emitted or reflected, coming from a point situated beyond the Moon, which reinforced the spectrum given off by the solar light reflected by our atmosphere.

This light, undoubtedly, can be no other than that of the solar atmosphere, or Corona, visible during total eclipses of the Sun.

If this reasoning is sound, the conclusions to be drawn from these observations are that the Corona, or at least traces of it, was visible during this partial eclipse, and that it was much brighter in the northwest equatorial regions than it was in the East; and, furthermore, that in the West it was less and less brilliant as it was observed northward, until it was completely invisible in the northern regions of the Sun. L. TROUVELOT.

CAMBRIDGE, *December* 31, 1880.

JUPITER.

OBSERVATIONS OF THE GREAT RED SPOT.

Having devoted most of my observing time this year to the phenomenæ of Jupiter, I would respectfully submit a few observations of the great red spot, situated in the south temperate zone of the planet.

Up to December 14, (the last observation on account of cloudy weather,) I have observed forty transits of the red spot across the central meridian. Thirty-four of these have been complete transits, *i. e.*, the preceding end the middle and the following end being observed.

The following table contains twenty-nine of these transits and is given in Greenwich mean time. The first, third and fifth columns give the observed time of passage of the preceding end, the middle and the following end of the spot.

Columns two, four and six, contain the times by which each portion of the spot preceded the passage of an assumed meridian that has a rotation period of $9^h\ 55^m\ 27.^s08$ (an ephemeris of the transits of this meridian has been published at intervals in the *English Mechanic*, by Herr A. Marth of the Royal Astronomical Society, and is corrected for parallax, velocity of light and phase).

The last column (7) contains the duration of transit in minutes, that is, the interval between the passage of the *P* and *F ends*.

TRANSIT OF JUPITER'S GREAT RED SPOT.

GREENWICH m. t. 1880.	1 Transit of P. end.	2 Preceding Ass'd Meridian.	3 Transit of Middle.	4 Preceding Ass'd Meridian.	5 Transit of F. End.	6 Preceding Ass'd Meridian	7 Duration of Transit.
	h. m.	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*m.*	*m.*
August 30	17 21.9	1 34.7	17 45.4	1 11.2	18 11.4	45.2	49.5
September 9	15 38.9	1 26.6	16 02.4	1 03.1	16 26.4	39.1	47.5
" 14	------	-----	15 14.4	55.4	------	----	----
" 16	16 19.4	1 27.2	16 49.4	57.2	17 11.4	35.2	52.0
" 18	18 01.4	1 22.0	18 24.9	58.5	18 50.4	33.0	49.0
" 25	18 45.0	1 19.5	19 09.7	54.9	19 32.3	32.2	47.3
" 28	16 15.5	1 16.5	16 40.1	51.9	17 03.9	28.1	48 4
" 30	17 51.5	1 17.3	18 19.5	49.3	18 44.0	24.9	52.5
October 1	13 44.3	1 15.2	14 12.0	47.5	14 39.0	20.5	54.7
" 6	12 48.7	1 15.1	13 16.7	47.1	13 44.7	19.1	56.0
" 7	18 32.2	1 17.7	19 00.2	49.7	19 27.0	22.9	54.8
" 10	16 00.7	1 16.7	16 26.7	50.7	16 55.7	21.7	55.0
" 13	13 31.2	1 13.8	13 57.2	47.8	14 23.0	22.0	51.8
" 20	14 16.0	1 10.5	14 40.0	46.5	15 03.8	22.7	47.8
" 23	------	-----	16 17.2	46.2	------	----	----
November 1	14 04.9	1 08 1	14 34.7	38.3	14 56.5	16.5	51.6
" 4	------	-----	12 01.0	39.9	12 25.2	15.7	----
" 8	14 52.0	1 03.3	15 16.7	38.5	15 43.1	12.2	51.1
" 10	16 30.2	1 02.2	16 55.0	37.5	17 19.4	13.0	49.2
" 11	12 20.1	1 03.2	12 42.9	40.4	13 11.2	12.1	51.1
" 18	13 03.2	1 02.8	13 28.0	40.0	13 54.8	11.4	51.4
" 20	14 44.2	59.1	15 08.7	34.6	15 34.0	9.4	49.8
" 22	16 25.9	54.8	16 47.2	31.5	17 15.5	5.2	49.6
" 23	12 18.2	53.4	12 39.5	32.1	13 06.2	5.4	48.0
December 2	14 42.9	49.5	15 02.2	30.2	15 27.9	4.5	45.0
" 5	12 12.9	48.1	12 32.2	28.8	12 57.2	3.8	44.3
" 7	13 46.5	52.0	14 10.0	28.5	------	----	----
" 9	15 24.9	50.2	15 49.3	25.8	16 12.7	2.4	47.8
" 14	14 33.2	49.3	14 56.0	26.5	15 21.4	1.1	48.2

The above table shows that the red spot varies considerably in length. These variations are shown in the last column, marked "Duration of Transit."

Assuming that the red spots period of rotation is $9^h\ 55^m\ 37^s.065$—which is probably very near the truth—we find that in one minute of time 0°.604 of the surface will pass a given meridian. Multiplying the minutes in the last, or column 7, by .604, we get the following table of lengths in longitude on the surface of Jupiter. The first nine are taken from a table of eleven transits observed by me previous to August 30, and published in *English Mechanic*, No. 809:

July	10, 1880	40°.45	Oct.	6, 1880	33°.82
"	17, "	26 .58	"	7, "	33 .10
"	24, "	27 .78	"	10, "	33 .22
"	29, "	32 .62	"	13, "	31 .29
"	31, "	30 .20	"	20, "	28 .87
Aug.	13, "	33 .82	Nov.	1, "	31 .17
"	16, "	23 .86	"	8, "	30 .86
"	17, "	27 .78	"	10, "	29 .72
"	23, "	27 .78	"	11, "	30 .86
"	30, "	29 .90	"	18, "	31 .05
Sept.	9, "	28 .75	"	20, "	30 .08
"	16, "	31 41	"	22, "	29 .96
"	18, "	29 .60	"	23, "	28 .99
"	25, "	28 .57	Dec.	2, "	27 .18
"	28, "	29 .23	"	5, "	26 .76
"	30, "	31 .71	"	9, "	28 .87
Oct.	1, "	33 .04	"	14, "	29 .11

On July 10 the spot had a narrow strip running from its preceding end. To this is due the great length of the spot on that date. This does not indicate the true length of the spot proper, but as it was a portion of the spot, or continuation, I give the length on that date.

It must not be supposed that, because I have carried the lengths to two places in the decimals, I consider the length accurate to that degree, for the observations have been entirely eye estimations, yet they were very carefully made. I think a variation of one degree in the length of the spot would be easily detected, and probably a less amount, as the agreement between most of the figures is too close and regular to attribute to chance. As my method of observing may be of interest, I will give an example from my note book. First: I watch closely the first end of the spot, and imagine a line dropped from it to the equatorial belt and observe when this is central, for it is much easier to halve the straight edge-like line of the equatorial belt than to halve the disk on a parallel with the spots centre, because the spot itself being on one side of the meridian biases our judgment to a certain extent, while the clean edge of the equatorial belt is free of any obstacle to interfere with our judgment. Second: I compare the spaces between the limbs of the planet and the ends of the spot, when these are seen to be equal, of course the spots centre is in transit. For determining the transit of the following end, the same method as that in determining the preceding end is followed. At the observation of each part of the spot there exists for a short while a period of uncertainty. The beginning of this uncertainty I indicate by *u*, noting the time. In a minute or so I feel sure the time of true phase has arrived, this is noted by *t*, with its time. Shortly, I am certain the phase has passed, this I note as *c*, with its time. The mean of the three is taken for the true phase.

The following is an observation of the transit of the red spot on October 13, 1880, Nashville, *mt*, taken from my note book.

		h. m.	h. m.	h m.
P	*u*	7 40	7 44	
	t	7 44		
	c	7 48		
M	*u*	8 07	8 10	8 09.9
	t	8 10		
	c	8 13		
F	*u*	8 32.5	8 35.8	
	t	8 36.5		
	c	8 38.5		

The mean of the nine observations agrees with the observed middle transit to .1 m. This close agreement cannot, of course, be expected often. However, they generally agree to within a few fractions of a minute. In no case have I allowed myself to know beforehand what time any phase *should* occur, as this might influence the observations.

The variations in length of the spot are not only shown by the duration of transit, but are sensible to an observing eye. At each observation I estimate its length, comparing it with the breadth of the disk on the same parallel of latitude. These comparisons show changes in its length, as they vary from 1-3.5 to ⅓ the breadth of the disk, but it is generally the slightest bit less than one-third.

The variations in breadth are compared with the great equatorial band, but unfortunately this is a standard that probably varies itself. The spot's breadth is generally slightly less than ½ the width of the equatorial belt, sometimes it is probably fully half as broad as the belt, but I have never seen it broader than that.

Changes in the width of the space between the south edge of the equatorial belt and the north edge of the spot, are more readily detected, as the space can be easily compared with the breadth of the spot. This space is generally equal to ⅓ the spot's breadth, yet it is sometimes nearly one-half as broad as the spot. I have seen it diminished to one-sixth. These changes are due either to a swelling out of the spot or a broadening of the equatorial belt. It is more likely due to changes in the spot. I have on several occasions estimated that the distance between the southern edge of the equatorial band and the southern edge of the spot was about equal to one-third the distance from the south pole to the equatorial belt.

There are sometimes slight changes in the general form of the spot; at times the ends are blunt or rounded, again they are cigar shaped. One end has been seen rounded while the other was very much pointed. The sides are at times a little flattened, but are generally slightly rounded. On July 24 the south-side was curved or convex, while the north-side was somewhat flattened. It is sometimes long and lanky and then again it is fat and "chubby"—neither of these have been carried to extremes. Faint continuations, or trails, have been visible, sometimes from one end and then from the other. These have on several occasions been seen trailing from both ends at once, but are not always seen without close looking. At times the spot is a deep solid brick color; then again it is lightish red and pale. I have never, for certain, seen any detail on the surface of the spot, but I have sometimes thought that there *was* detail but just too indefinite for my aperture. The outline of the spot is always clean—no diffusion.

These observations are from notes and sketches which I have made this year with a 5-inch Byrne refractor.

E. E. BARNARD.

NASHVILLE, TENN., *December* 27, 1880.

NOTE.—The motions of the spots on Jupiter, in an article by me in "SCIENCE" No. 24, are referred to an assumed rotation period of 9h. 55m. 27.08s., which should have been stated in that article. E. E. B.

PENNULE'S COMET.

The following position of this comet was obtained by ring micrometer, on December 30, 1880, 7h. 01.2 m., Nashville m. t.:

R. A. 19h. 55m. 38.5s.

Dec. + 18° 52′ 39.6″

It is several minutes in diameter and very brightly condensed. E. E. BARNARD.

NASHVILLE, Tenn., Jan. 2, '81.